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GB 1545500 A GB 0980575 A

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(54) A method of and apparatus for transporting an object to an underwater location

(57) A method of and apparatus for transporting an object to an underwater location is described. The apparatus comprises a floating submersible structure 1 having a pay load area 5. The structure 1 comprises ballast tanks 3, 4 which may be filled with or emptied of ballast to alter the buoyancy of the submersible structure 1. Pulling means 6 is mounted on the structure 1 and connection means 10 are provided for coupling the structure 1 to the bottom of the body of water (23, fig 4b). The connection means 10 engages the pulling means 6 and the pulling means 6 is adapted to pull the submersible structure 1 to the bottom by pulling on the connection means 10 when the connection means is coupled to the bottom e.g. by the provision of anchors (27).

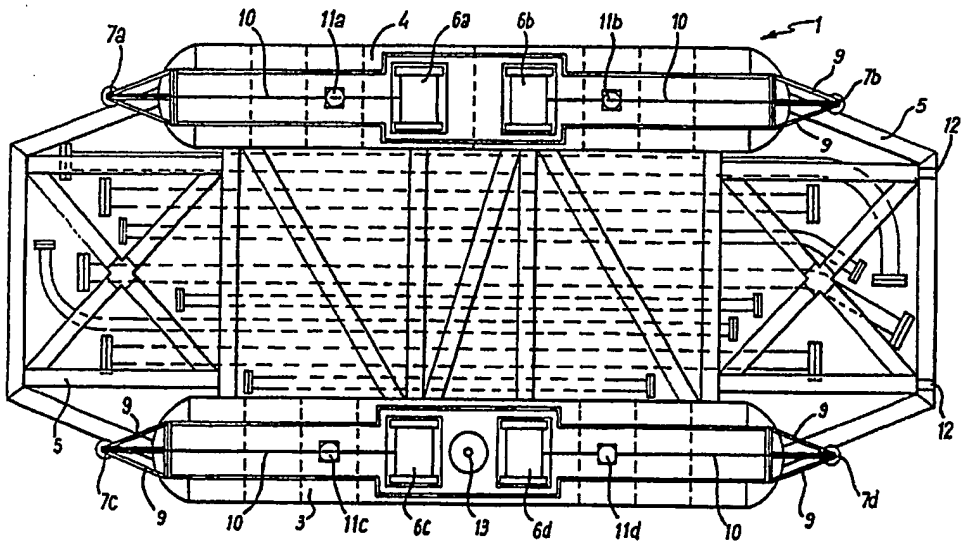

FIG.3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply

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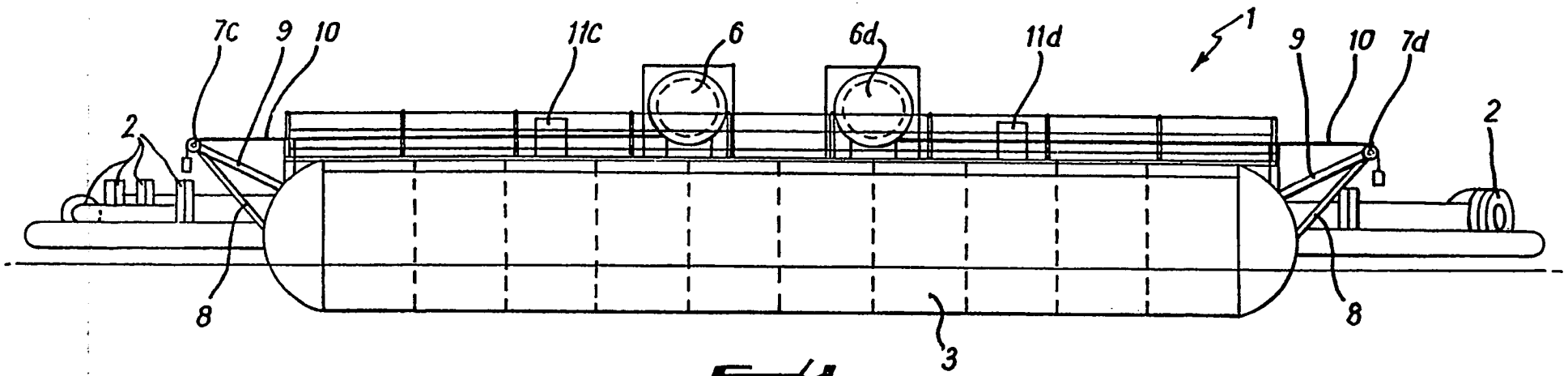


FIG.1

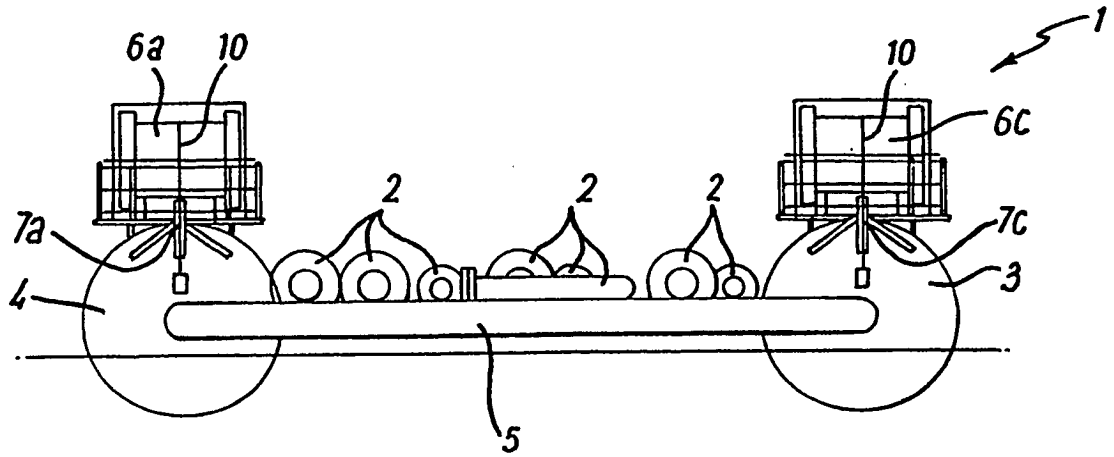
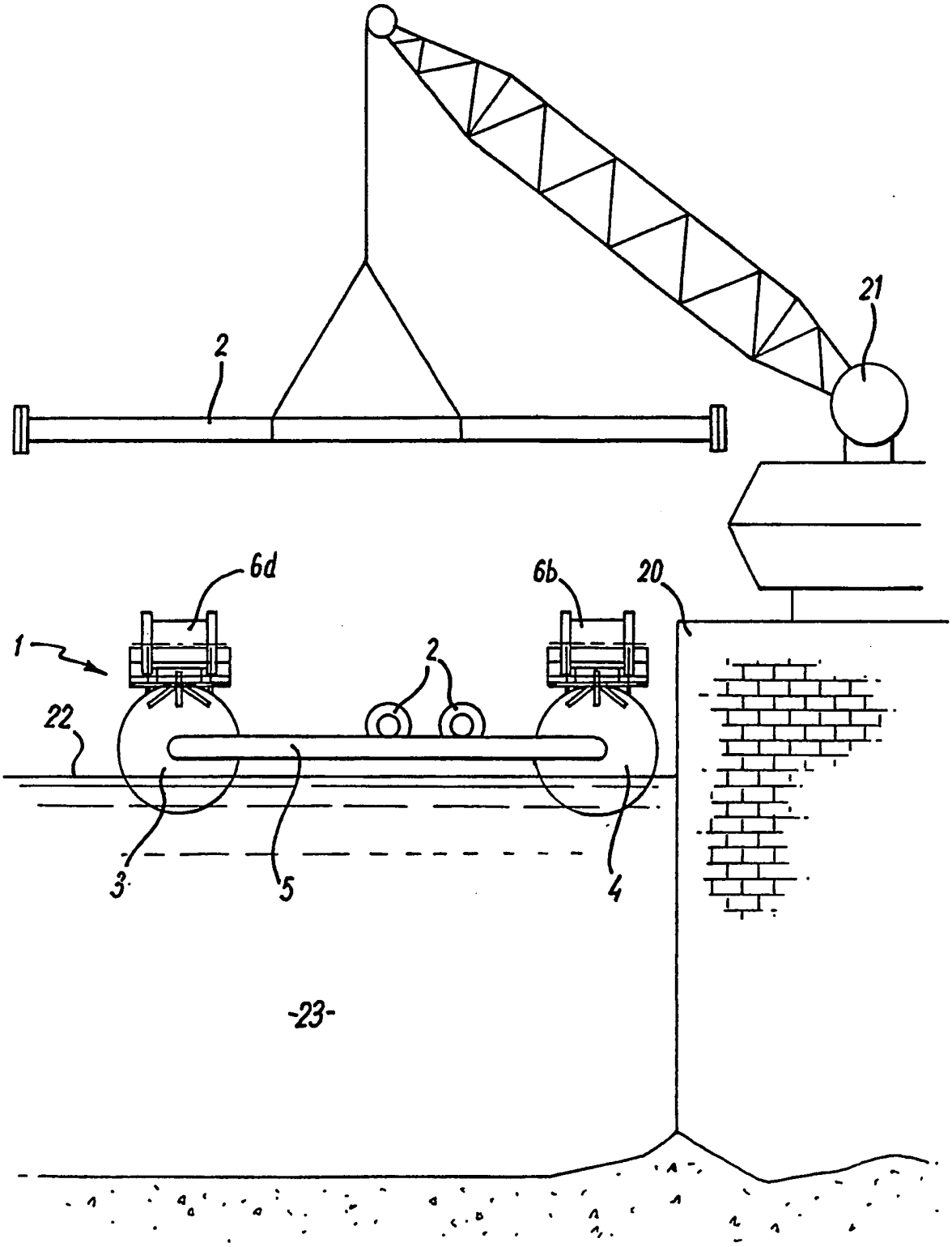


FIG.2



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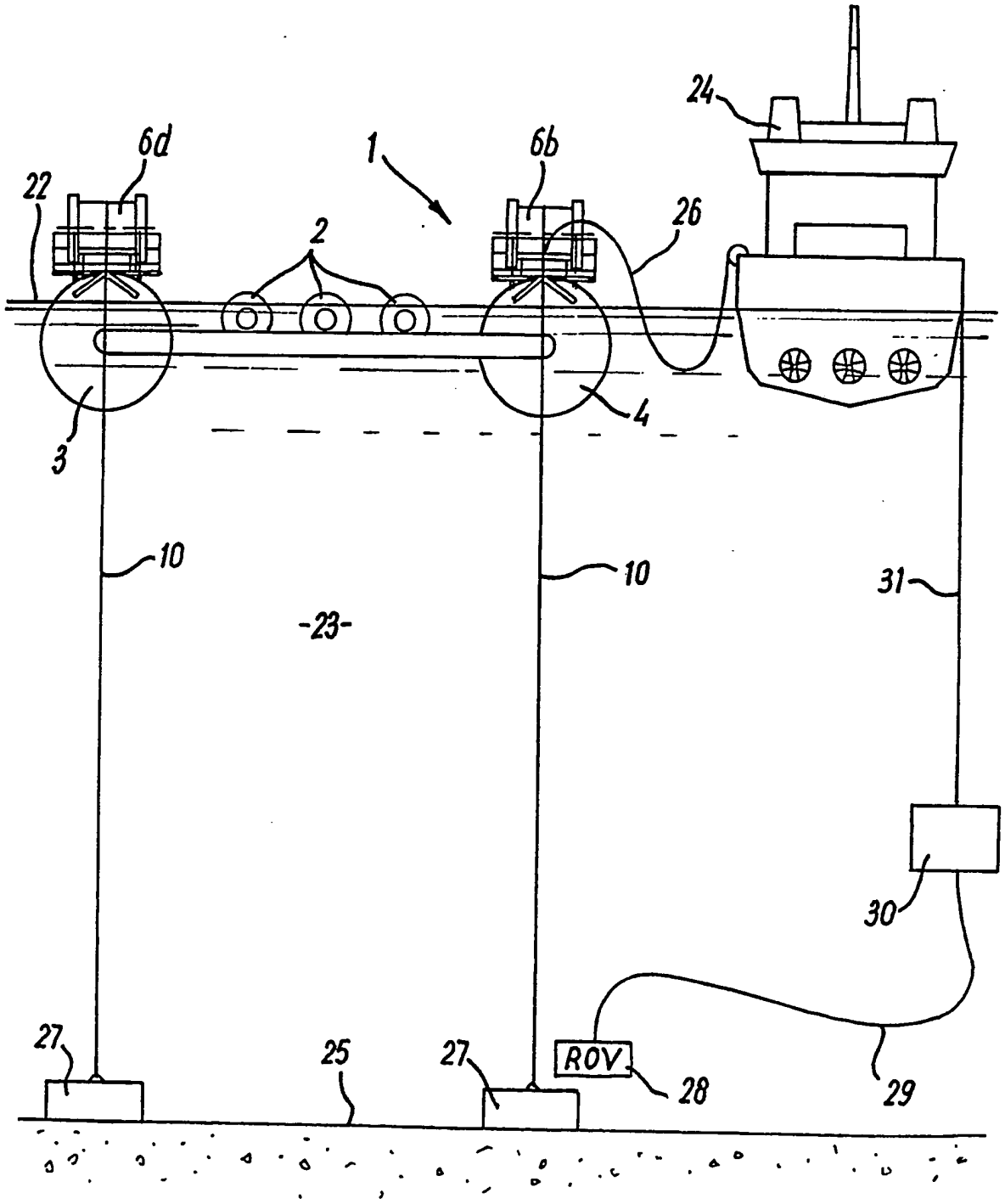

FIG. 4b

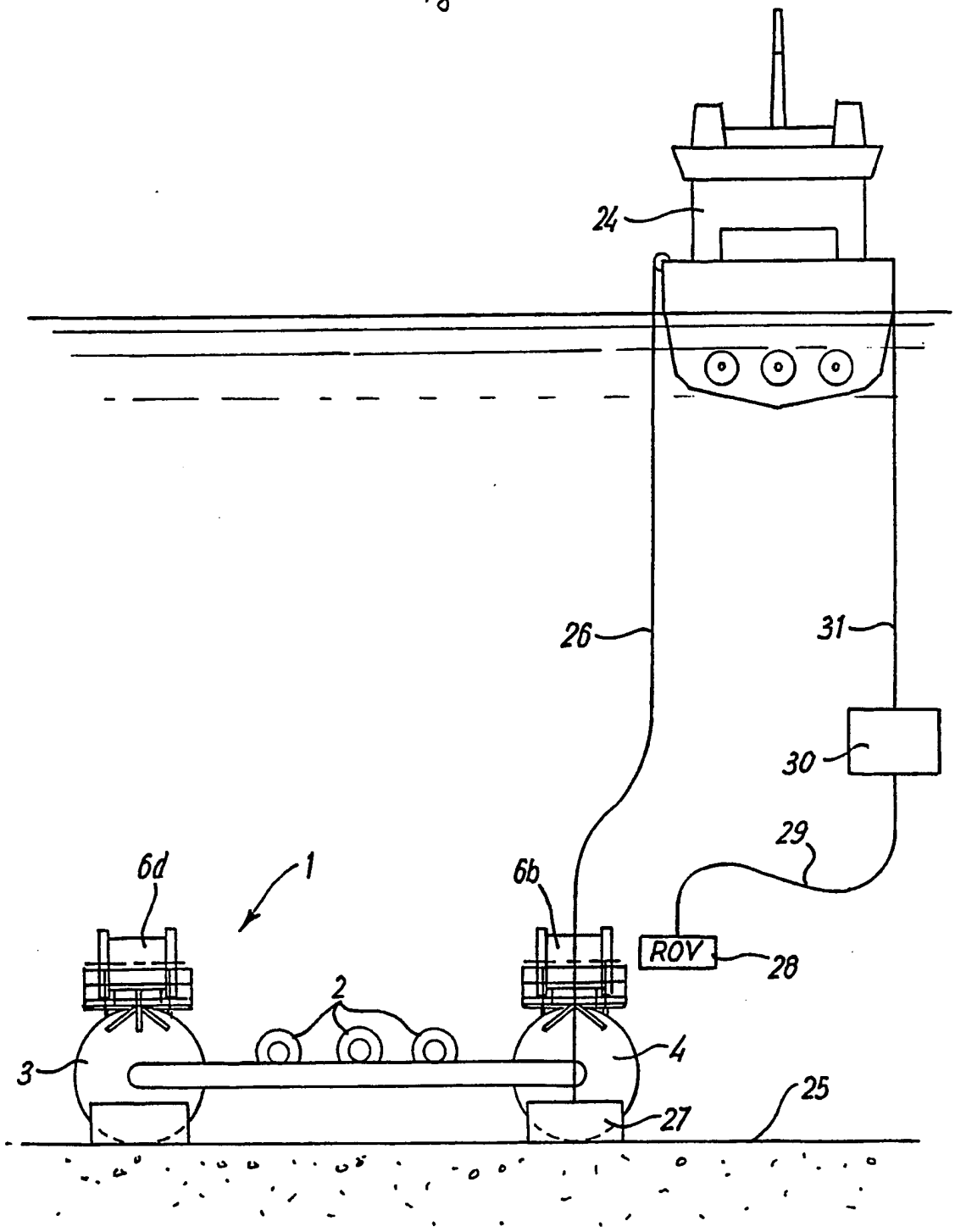

FIG. 4C

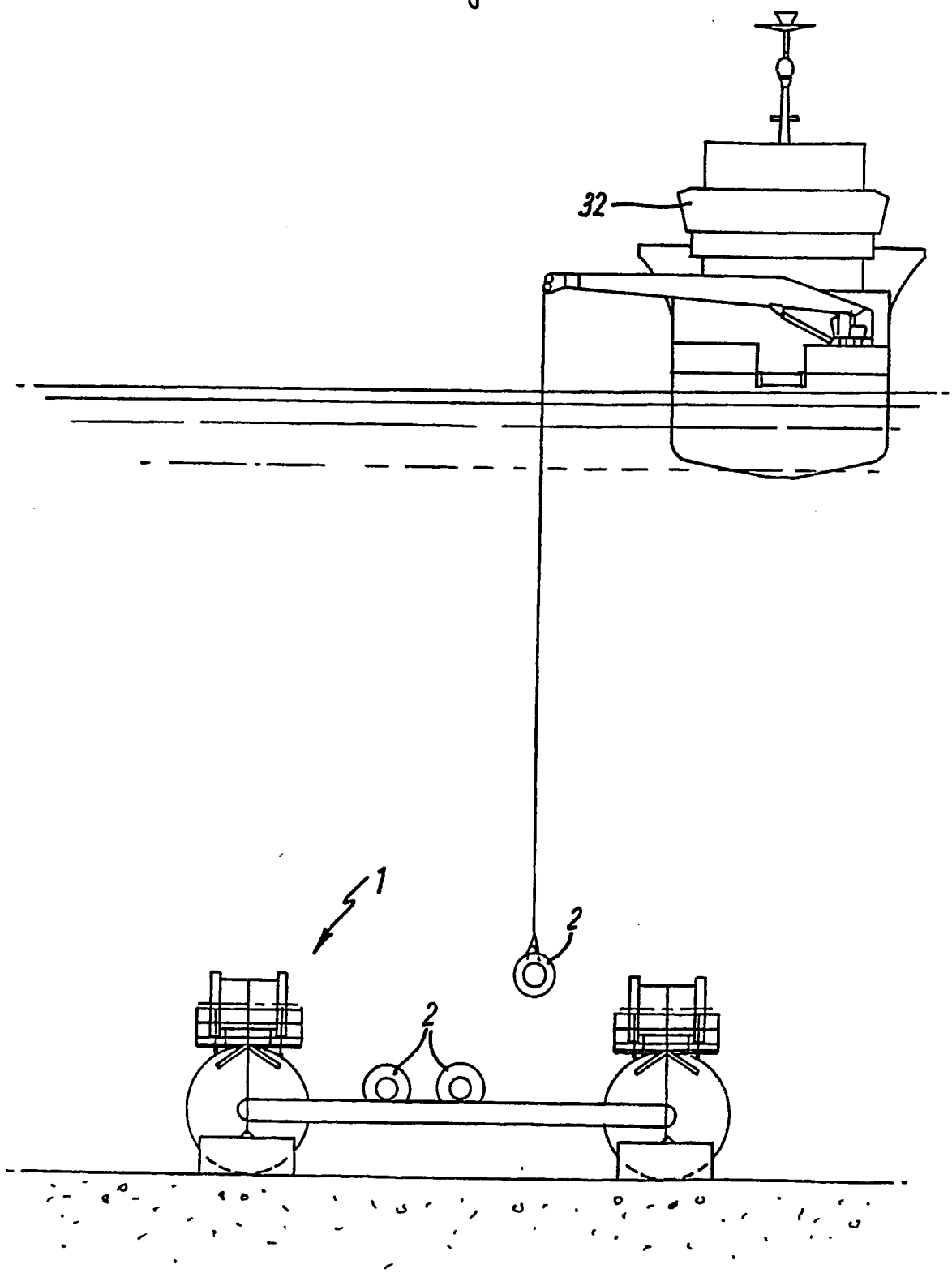

FIG_4d

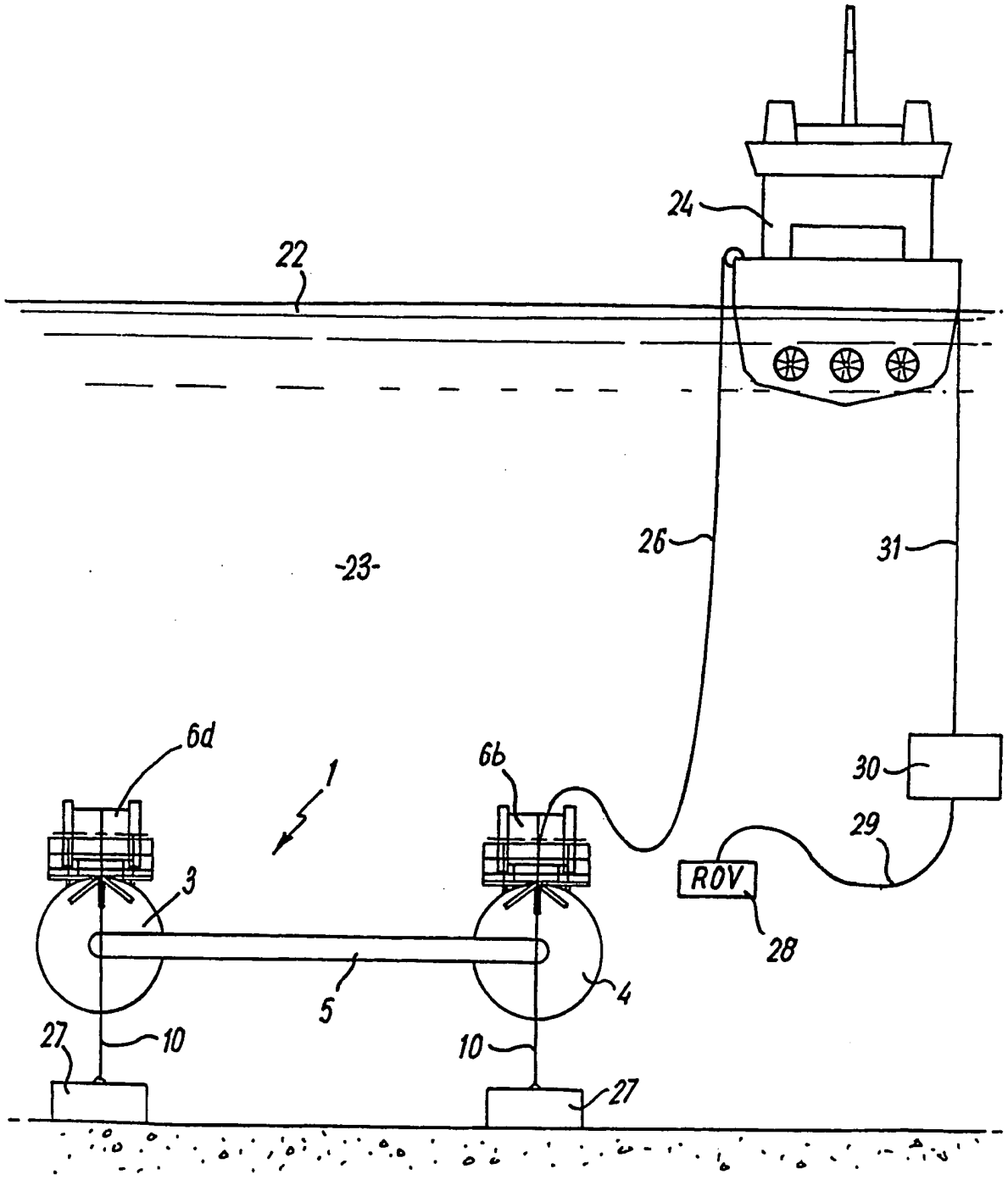

FIG_4e

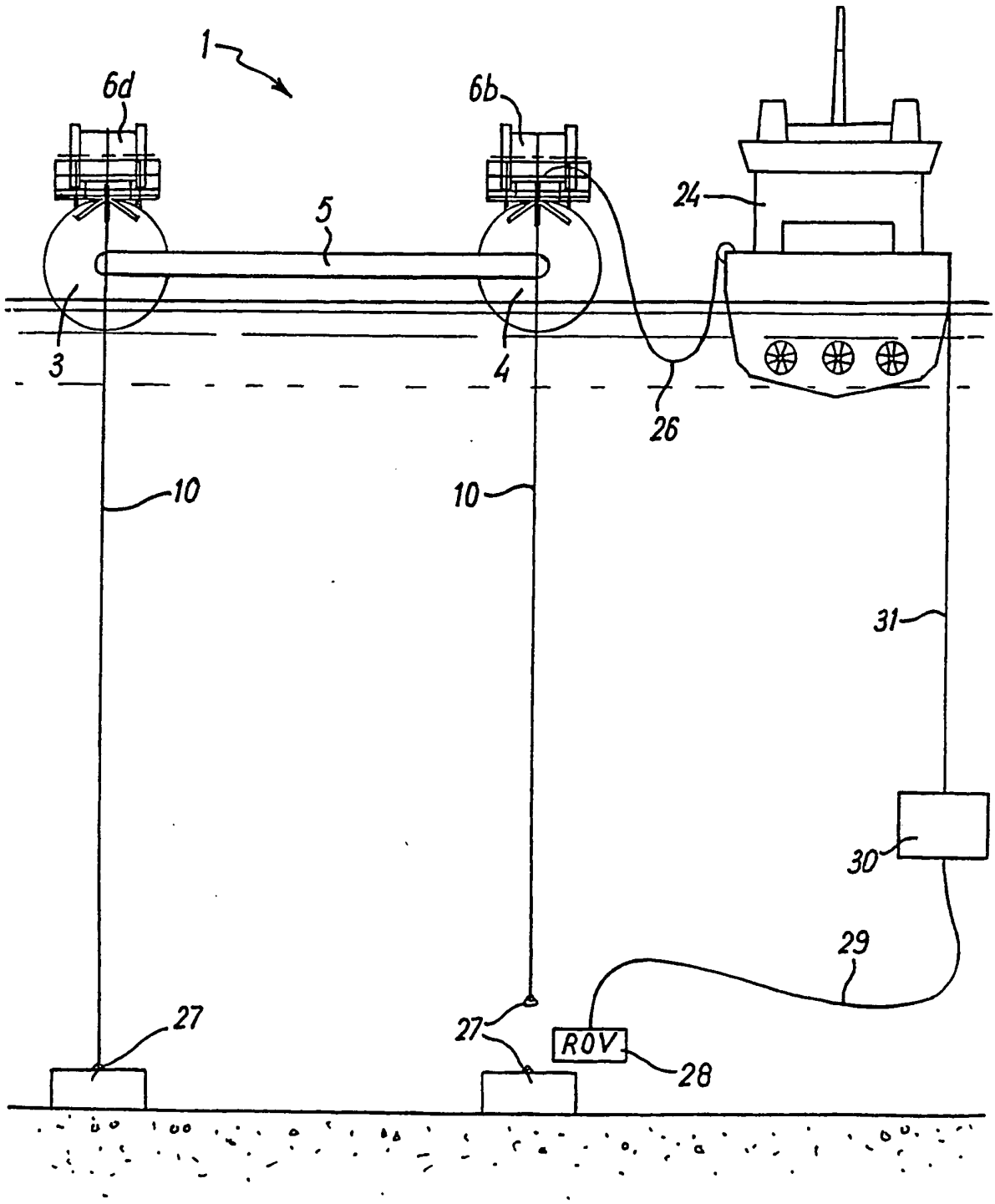

FIG. 4f

"A Method of and Apparatus for Transporting an Object to an Underwater Location"

The invention relates to a method of and apparatus for transporting objects to an underwater location.

Conventional methods of moving heavy and bulky objects offshore to an underwater location have involved using a vessel to transport the object to above the underwater location and then using a crane barge to lift the object from the vessel and lower it into location underwater.

This previous method has the disadvantage that both vessels are required to be on location simultaneously during the unloading operation. With bulky objects it may be necessary to use a relatively large crane arm radius which can result in requiring a large and therefore expensive crane to manoeuvre the load into position. Typically, the load capacity of a crane reduces with the increase in radius of the lifting point from the central crane support and often this reduction can be very rapid. For example, a crane may have a load capacity of 30 tons at a radius of 20

metres but a load capacity of only 5 tons at a radius of 24 metres.

In accordance with an aspect of the present invention, a method of transporting an object to an underwater location comprises placing the object on a floating submersible structure, propelling the submersible structure with the object to a location on the surface of the water in the vicinity of the underwater location, coupling the submersible structure to the bottom of the body of water below the submersible structure and submersing the submersible structure by pulling the submersible structure to the bottom while maintaining a positive buoyancy in the submersible structure.

In one example of the method, the object may be subsequently moved from the submersible structure to the underwater location. However, in another example of the method, the object is situated in the underwater location when the submersible structure reaches the bottom of the body of water.

In the first example, the submersible structure may be recovered from the bottom and re-used. In the second example, the submersible structure remains at the underwater location and may be used to recover the object at a later date.

In accordance with another aspect of the present invention, apparatus for transporting an object to an underwater location comprises a floating submersible structure having a pay load area, the structure comprising a ballast tank which may be filled with or emptied of ballast to alter the buoyancy of the

submersible structure, pulling means mounted on the structure and connection means for coupling the structure to the bottom of the body of water, the connection means engaging the pulling means wherein the pulling means is adapted to pull the submersible structure to the bottom by pulling on the connection means when the connection means is coupled to the bottom.

Typically, the connection means may be a cable or chain and may be coupled to the bottom by means of an anchor device which for example, could be a heavy weight which couples the connection means to the bottom by means of its own weight or alternatively, could be by means of a releasable connector having one section fixed to the sea bed and the other section fixed to the coupling means, whereby the two sections engage with each other to couple the connection means to the bottom.

In one example, the anchor device could be transportable and could be carried on the apparatus when transporting the object to the underwater location.

Typically, a number of pulling means are provided and preferably, a connection means is associated with each pulling means. In the preferred arrangement, four pulling means and four connection means are provided.

Preferably, the pulling means may be in the form of winding means, such as a winch and the connection means is typically wound round the winding means.

Typically, the apparatus may also include a tension monitor to monitor the tension in the connection means.

Typically, the buoyancy of the submersible structure is alterable on feedback received from the tension monitor. Preferably, a tension monitor is provided for each connection means, where appropriate.

Preferably, the apparatus includes towing means to permit the apparatus to be towed to the location. Alternatively, it is possible that the apparatus could be fitted with self propulsion means.

Typically, the apparatus is not normally manned and the operation of the pulling means and ballast of the buoyancy means may be adjusted by use of a control line connecting the apparatus to another structure, which may be a floating structure such as a ship. The control line may be in the form of an umbilical connection.

A method of and apparatus for transporting an object to an underwater location in accordance with the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a side view of the apparatus;
Fig. 2 is an end view of the apparatus;
Fig. 3 is a plan view of the apparatus; and
Figs. 4A to 4F show the apparatus of Figs. 1 to 3 in use.

Fig. 1 is a side view of apparatus 1 for transporting objects to an underwater location. In this example, the objects shown are lengths of pipe 2 which are to be installed in the seabed. The apparatus 1 comprises two large tubular members 3, 4 which form ballast tanks and permit the buoyancy of the apparatus 1 to be adjusted.

The tubular members 3, 4 are interconnected by a framework 5 which extends between the tubular members 3, 4 and provides a pay load platform for the lengths of pipe 2. Mounted on the tubular members 3, 4 are four marine winches 6a, 6b, 6c, 6d two winches being mounted on each tubular member, as shown in Figs. 1 to 3. Fairleads 7a, 7b, 7c, 7d are mounted at each end of the tubular members 3, 4 by means of supporting struts 8, 9. The fairleads convey cable 10 from the respective winch 6a to 6d over each end of the tubular members 3, 4. Located between each marine winch 6a-6d and each respective fairlead 7a-7d is a tension monitor 11a, 11b, 11c, 11d to monitor the tension in the cables 10. The apparatus 1 is also provided with towing points 12 to permit the apparatus 1 to be towed behind a vessel. The tubular members 3, 4 are also provided with valve devices (not shown) to permit the tubular members 3, 4 to be flooded with water or alternatively to enable the tubular members to have water pumped out from them. An umbilical connection point 13 is provided on the top surface of tubular member 3 and this is coupled to the winches 6a-6d, tension monitors 11a-11d and valve devices, to control their operation.

In use, the apparatus 1 is moored beside a dock 20 and lengths of pipe 2 are lowered onto the pay load support area formed by the frame 5 by a conventional dockside crane 21, as shown in Fig. 4A. After loading the lengths of pipe 2 onto the apparatus 1, the tubular members 3, 4 have their ballast adjusted to ensure that the apparatus 1 is properly balanced and that it is floating correctly on surface 22 of water 23.

The apparatus 1 with the pipes 2 is then towed by a vessel 24 to the desired location above seabed 25 and

an umbilical 26 connected to the connection 13 between the vessel 24 and the connection 13 to control the operation of the winches 6a-6d and ballasting of the tubular member 3, 4 from the vessel 24. The winches 6a-6d are operated to unwind cable 10 to the seabed where they may be anchored by means of anchors 27.

The anchors 27 could be permanently fixed to the seabed or could be transportable and carried on the apparatus 1 during towing.

The anchors 27 may be heavy weights, such as concrete blocks, or alternatively, could take the form of connectors which releasably engage cable 10 with the seabed 25 and in this case a remotely operated vehicle (ROV) 28 operating via an umbilical 29 from a tether station or garage 30, which is connected to the vessel 24 by an umbilical 31, could be used to facilitate connection of the cables 10 to the anchors, as shown in Fig. 4B. The tubular members 3, 4 are flooded to decrease the buoyancy of the apparatus 1 until the apparatus 1 has a buoyancy which is less than the total load which may be exerted using the four winches 6a-6d. When this condition is reached, operation of the winches 6a-6d to wind in the cable 10 will cause the apparatus 1 to become submerged as the winches 6a-6d pull the apparatus 1 towards the seabed 25. During this operation, the tension monitors 11a-11d monitor the tension in cables 10, to ensure the apparatus 1 is correctly balanced and no excess land is present on the cables 10. If necessary the buoyancy of the apparatus can be adjusted accordingly. When the apparatus 1 reaches the seabed 25, as shown in Fig. 4C, the tubular members 3, 4 are fully ballasted to minimise any possible movement of the apparatus 1 on the seabed and

the ROV 28 may then disconnect the umbilical 26 from connection 13 to permit the vessel 24 to leave the apparatus 1 with pipes 2 moored on the seabed 25.

A crane on a vessel 32 may then be used to transfer the lengths of pipe 2 from the apparatus 1 to the appropriate location on the seabed and divers and/or ROVs may be used, if appropriate, to assist in the final location (See Fig. 4D).

After the lengths of pipe 2 have been removed from the apparatus 1, the vessel 24 (or a different vessel) may return to the location and the umbilical 26 reconnected to the umbilical connection point 13 on the apparatus 1 by the ROV 28 and the tubular members 3, 4 unballasted, for example by pumping air or another gas into the tubular members 3, 4 to expel some of the water to make the apparatus 1 buoyant. Hence, as the winches are operated to unwind cable 10, the apparatus 1 rises to the surface 22 of the water 23, as shown in Fig. 4E.

When the apparatus 1 is on the surface, the ROV may be used to disconnect the anchors 27 and the cable 10 wound back onto the winches 6a-6d. The apparatus 1 may then be towed back to dock and reused as necessary.

Hence, the invention has the advantage of providing a method and apparatus for transporting objects to an underwater location by only lifting the objects while they are submerged. This permits a lower crane capacity to be used as the weight required to be lifted is only the submerged weight of the object and not the weight of the object in air and in addition, the crane may be located above the object being lifted to reduce the radius of the boom of the crane to permit a lower

capacity crane to be used for the lifting operation.

In addition, the invention also has the advantage that only the vessel on which the crane is located is moving on the water. This mitigates the dangers and problems associated with lifting objects from another moving vessel on the sea where relative movement between the vessel on which the crane is located and the vessel on which the objects being removed are located can cause problems.

Also, because relative movement between vessels is mitigated, the conditions which can be tolerated during the operations can be more extreme.

Furthermore it is not essential that the crane vessel and the vessel 24 which locates the apparatus 1 are at the location simultaneously which can be expensive if there are delays in the unloading operations.

Modifications and improvements may be incorporated without parting from the scope of the invention.

CLAIMS

1. A method of transporting an object to an underwater location comprising placing the object on a floating submersible structure, propelling the submersible structure with the object to a location on the surface of the water in the vicinity of the underwater location, coupling the submersible structure to the bottom of the body of water below the submersible structure, submersing the submersible structure by pulling the submersible structure to the bottom while maintaining a positive buoyancy in the submersible structure, and locating the object at the underwater location.

2. A method according to claim 1, wherein the object is moved from the submersible structure to the underwater location after the submersible structure has reached the bottom.

3. A method according to claim 1, wherein the object is situated in the underwater location when the submersible structure reaches the bottom of the body of water.

4. A method according to claim 2 or claim 3, wherein the submersible structure is used to recover the object from the underwater location.

5. Apparatus for transporting an object to an underwater location comprising a floating submersible structure having a pay load area, the structure comprising a ballast tank which may be filled with or emptied of ballast to alter the buoyancy of the submersible structure, pulling means mounted on the

structure and connection means for coupling the structure to the bottom of the body of water, the connection means engaging the pulling means wherein the pulling means is adapted to pull the submersible structure to the bottom by pulling on the connection means when the connection means is coupled to the bottom.

6. Apparatus according to claim 5, wherein the connection means is coupled to the bottom by means of an anchor device.

7. Apparatus according to claim 6, wherein the anchor device comprises a releasable connector to releasably connect the connection means to the anchor device.

8. Apparatus according to claim 6 or claim 7, wherein the anchor device is carried on the apparatus when transporting the object to the underwater location.

9. Apparatus according to any of claims 5 to 8, wherein the pulling means is in the form of a winding means.

10. Apparatus according to any of claims 5 to 9, wherein the apparatus also includes a tension monitor to monitor the tension in the connection means.

11. Apparatus according to claim 10, the apparatus also including buoyancy control means which controls the buoyancy of the submersible structure in response to signals received from the tension monitor.

12. Apparatus according to any of claims 5 to 11, wherein a number of connection means are provided.

13. Apparatus according to claim 12, wherein four connection means are provided.

14. Apparatus according to claim 12 or claim 13, wherein a pulling means is provided for each connection means.

15. Apparatus according to any of claims 5 to 14, wherein the apparatus includes a control line to couple the apparatus to a control centre on another floating structure to permit the apparatus to be controlled remotely from the other floating structure.

16. Apparatus for transporting an object to an underwater location, substantially as hereinbefore described with reference to any of the accompanying drawings.

17. A method of transporting an object to an underwater location, substantially as hereinbefore described with reference to any of the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) -12-	Application number GB 9409531.2
Relevant Technical Fields (i) UK Cl (Ed.M) E1H (HEA); B7V (VEA); B7A (AGT) (ii) Int Cl (Ed.5) B63B 35/00, 35/44; E02B 17/00, 17/02	Search Examiner A HABBIJAM Date of completion of Search 18 JULY 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-17

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1545500	(AYLMER OFFSHORE LTD) See in particular Figures 1 and 10	1, 3-9, 12, 14
X	GB 0980575	(LASSEN-NIELSEN) See especially Figure 2 and related description	1-3, 5, 6, 9, 12, 14

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